We drove home most of the night pausing only for a short sleep at Viriginia Water, arriving home at 7.15 a.m. on 12th August.

End of the season notables were a *Tiliacea citrago* L. in the m.v. trap at Mucking on 11th September, a *Lithophane semibrunnea* Haw. from there on 27th September, and one *Griposia aprilina* L. at light on a field trip to Little Baddow on 10th October. Thus ended my season 1970, a season in which I had added 44 new species to my collection.

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Incomplete development and reduction in quantity of scales occuring occasionally in specimens bred in captivity

By B. C. S. Warren, F.R.E.S.

In a paper on hybridisation (Ent. Rec. Dec. 1970), I suggested that scales obtained from bred specimens might in certain cases be used in research provided it was known that such specimens were the progeny of wild-bred parents, not previously inbred for generations under unnatural conditions (l.c.p. 311). Actually it now appears that the use of scales derived from experimentally-bred specimens is not always to be relied on.

Recently, Mr S. R. Bowden and I had experienced difficulty in comparing the results of some observations so he kindly sent me a few of his microscopic slides to compare with my own. Among these were one of British *P. napi*, one of Swiss *P. bryoniae* and one of Scandinavian *P. adalwinda*, made from specimens he had bred at different times.

I examined the *P. napi* first and found a number of abnormal scales. The specimen was pure-bred, but showed some scales approximating those known in hybrids between that species and *P. bryoniae* but differing from such in being well-developed distally, but practically undeveloped in their proximal half. As I could not gain any information from this slide I turned to that of *P. bryoniae*. This was even more abnormal. There was not one typical *bryoniae*-scale in the mount, all were abnormal and undersized, so I turned to the *adalwinda* slide. Here again I met similar results. As the three specimens came from three different batches of larvae, some unnatural factor must have affected each.

The specimens were of the first generation forms (i.e. spring

generation), but the data showed that all had been retarded artificially and had not emerged until later in the summer. Mr Bowden had told me he found it necessary to hold emergence back by placing the pupae in a low temperature, so as to check emergence until required for some other experiment. It is known that the scales only attain full development shortly before emergence. I can therefore only conclude that the unnatural check in development resulted in this strange disturbance in the scales. Mr Bowden doubts this was the cause of the trouble, but is unable to give any exact reason. In this case it is not an accidental one occurring once but some more or less usual occurrence connected with his method of breeding. Further he had mentioned many times that "thinly scaled" specimens occurred among those he bred, though such are very rare in *Pieris* species in nature. I can only attribute this reduction in quantity of scales to the same cause: interference in development. Whatever the cause may be, the fact remains that some factors in breeding produced these abnormal results.

Mr Bowden thinks his specimens are not otherwise adversely affected and I have no doubt his methods are the same as those of most experimental breeders. But if the trouble was the result of some other cause or couses this only makes it worse, for it will only be waste of time and work examining scales from specimens bred by methods which may, or may not, give abnormal results. I have had bred specimens from Mr Bowden that gave perfectly developed scales, but can only think such specimens were simply bred from eggs of wild specimens and allowed to complete their emergence at the natural time. Possibly development checked at the normal time cannot be resumed at a later period.

In view of these uncertainties I must strongly advise those who wish to study the scales to work from wild-bred specimens only. This is most unfortunate, but certainly no specimen from the "stock" of an experimental breeder could be trusted to give normal results, for one must remember that such "stock" may have been inbred in captivity for a period of several years.

What makes the scales of such value as indications of relationship is their response to specific nature, as is shown by their correlation with the structural characteristics of the genitalia in many genera. (See the hundreds of detailed photographs of scales and genitalia in my "Monograph of the genus *Erebia*"). As the scales can in no way be affected by the genitalia or connected with the structural developments of those organs, their correlation is entirely a matter linked to specific nature. When the genitalia are of simple nature and show little tendency to develop specialised specific characters, the greater sensitivity of the scales is especially useful, though owing to their minute size they may require greater care and accuracy in observation.